Direct-Semidirect Neutron Capture Calculations Applied to R-Matrix Data Evaluations in the Resolved Resonance Region

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We present a method for computing direct-semidirect neutron radiative capture and its applications to R-Matrix evaluations of ^{19}F, ^{27}Al, ^{28}Si, and ^{35,37}Cl, performed by the Nuclear Science and Technology Data group at ORNL on neutron transmission and capture data measured at ORELA during the past few years. The method includes both direct and semidirect capture; the latter is a core-polarization term in which the giant dipole resonance is formed. We compare our method with that of T. Rauscher et. al, which has been commonly used in computations related to astrophysics, as well as in nuclear data evaluations.

For nuclear data evaluations in the resolved resonance region, where R-Matrix evaluations are commonly performed using the Sammy code, direct capture is significant in valleys between resonant capture peaks, as well as at very low neutron incident energy below the lowest resonance (e.g. thermal capture).

The experimental data for which the R-Matrix analyses are being performed is subject to background effects that at energies below 10 keV could be sufficiently large to obscure the direct capture cross section. Consequently, an accurate evaluation of TOF data requires a prediction of the direct capture cross section, to which end we apply our method.

This work was performed under the auspices of the U.S. Department of Energy by DE-AC05-00OR22725 and by the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

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